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Addendum for experiment IS433

SEARCH FOR NEW PHYSICS IN BETA-NEUTRINO CORRELATIONS USING TRAPPED IONS AND A RETARDATION SPECTROMETER

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Abstract

The WITCH set-up is a combination of two Penning ion traps and a retardation spectrometer for recoil ions from beta decay. It was installed at ISOLDE from 2001 to 2005. Since then the set-up was further optimized and extended, and first measurements were performed as well. In this addendum the present status of the experiment is described, first results are presented, plans for the near future are given and beam time is asked to perform further measurements.

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1. Introduction

The main components of the WITCH (Weak Interaction Trap for CHarged particles) set-up are a double Penning ion trap system and a retardation spectrometer. The system is designed primarily to measure the energy spectrum of recoil ions from beta decays in a Penning trap. The shape of this spectrum depends on the so-called β-ν angular correlation coefficient *a* [JAC57], which in turn depends on the structure of the weak interaction. The WITCH experiment [BEC03a, BEC03b, KOZ04] thus allows to probe the existence of physics beyond the Standard Model such as, e.g., scalar and tensor weak currents. A precision of ≈0.5 % or better on *a* is aimed at. At 0.5 % precision the sensitivity to scalar weak currents is similar to the present 95% upper limit of $|C_S/C_V| < 0.07$ [SEV06], and equal to the presently most precise result that was obtained in a β-ν correlation measurement with ^{38m}K in a Magneto Optical Trap at TRIUMF [GOR05].

Presently two ion trap based set-ups for β-ν correlation measurements exist. One was set up by the LPC-Caen group at GANIL [ROD06] to search for tensor weak currents in the pure Gamow-Teller β^- decay of ^{6}He. The ions are stored in a Paul trap and the β-ν correlation will be extracted from β-recoil coincidence measurements, determining the position and energy of the β particles with a plastic scintillator and a position sensitive Si detector, and measuring the position and time of flight of the recoil ions with a micro-channel plate detector. This experiment has recently obtained a preliminary data set that is now being used to study different types of systematic effects.
The other experiment is the WITCH experiment at ISOLDE (IS433). The proof of principle of this experiment was demonstrated about one year ago [KOZ08] and a first recoil ion energy spectrum has been measured [COE08]. Contrary to the LPCTRAP experiment the WITCH experiment will concentrate on scalar weak currents. In parallel our team is searching for tensor currents in beta-asymmetry measurements with polarized nuclei at NICOLE (experiment IS431). Here we give a status report and ask for beam time to perform further measurements with WITCH.

2. Lay-out and principle

An overview of the WITCH set-up [BEC03] is shown in figure 2. In a first step ions produced by ISOLDE are trapped by REXTRAP which transforms the ion beam into bunches. These are then sent through the horizontal beam line of WITCH and a 90° bender with spherical electrodes, into the vertical beam line. There the energy of the ions is reduced to about 100 eV above ground potential using a pulsed drift cavity (to avoid a HV platform). This beam is then injected into the 9T magnetic field where the two Penning traps are situated. First the ions are trapped in so-called cooler trap, where they are cooled in He buffer gas and mass selectively purified, and then injected through a 3 mm diameter differential pumping barrier into the second Penning trap, the decay trap. The latter is placed at the entrance of the retardation spectrometer. After β decay, the recoil ions emitted into the direction of the spectrometer spiral from the ion cloud situated in the strong magnetic field B_{max} = 9 T of the Penning trap into the homogeneous weak field region with B_{min} = 0.1 T in the centre of the spectrometer. According to the principle of adiabatic invariance of the magnetic flux, a fraction $1 - (B_{min}/B_{max}) \approx 98.9\%$ of the energy of the ion motion perpendicular to the magnetic field lines will be converted into energy of the ion motion along the magnetic field lines. In the homogeneous region of low magnetic field B_{min} the longitudinal kinetic energy of the recoil ions can then be probed by retarding them with a well-defined electrostatic potential. The ions that pass this analysis plane are reaccelerated to ~10 keV to get off the magnetic field lines. This reacceleration also ensures constant detection efficiency for all recoil energies. Finally, the ions are focused with an einzellens onto a microchannel plate (MCP) detector. By counting ions with the MCP for different retardation voltages, the integral recoil ion spectrum can be measured.

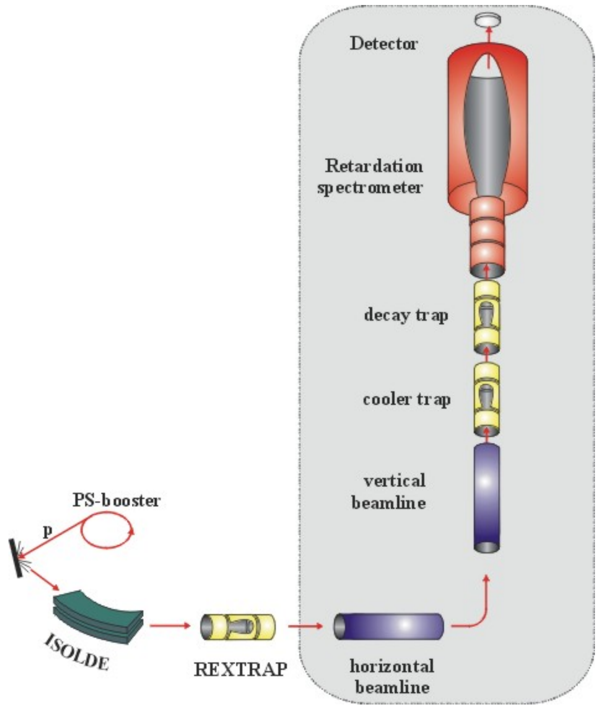

Figure 2: Schematic overview of the WITCH set-up at the ISOLDE/CERN facility

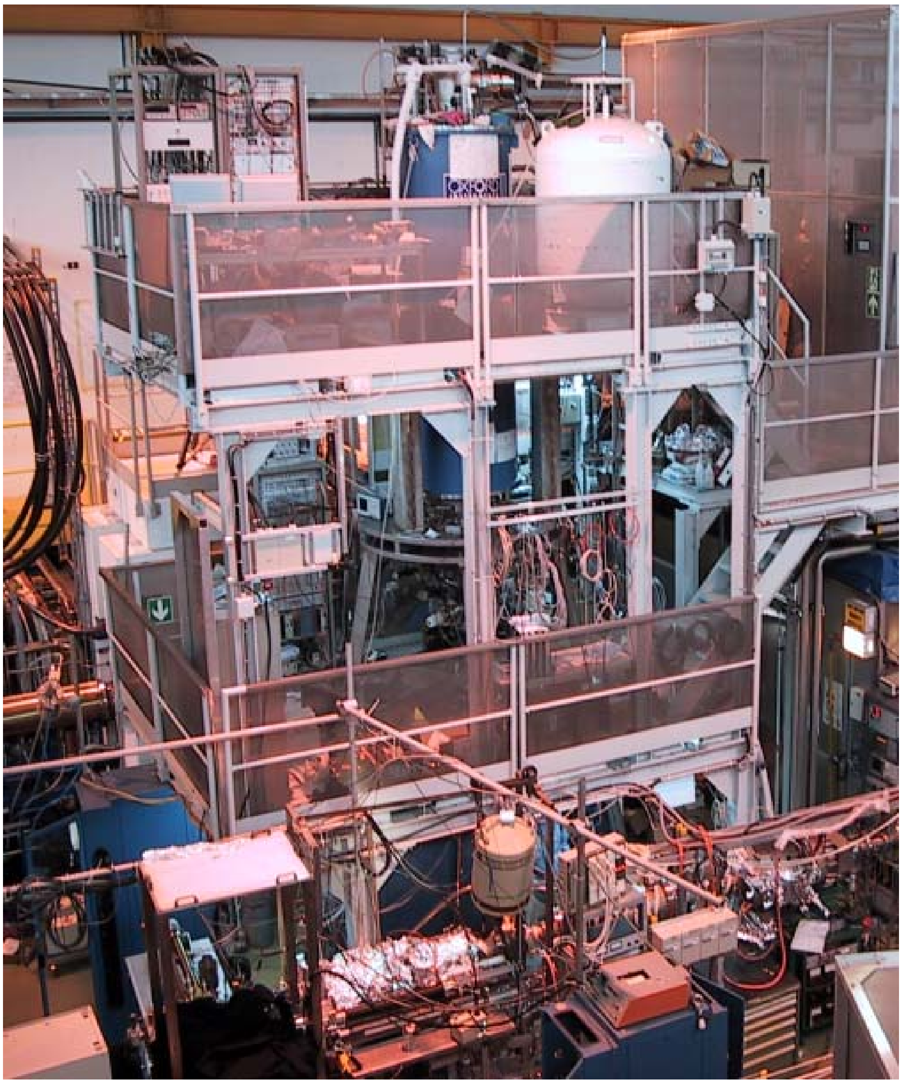

Figure 3: The WITCH set-up at the ISOLDE/CERN facility

Note that at the end of 2005 the University of Münster has joined the WITCH collaboration. They are mainly working on simulations to understand in detail the effects in the Penning traps, the transmission function of the retardation spectrometer and various other systematic effects (e.g. cut-off angle upon leaving the trap due to the magnetic field, …). About one year ago also the Nuclear Physics Institute of the Czech Academy of Sciences (Rez-near-Prague) has joined with at present as main task the development of a scintillator detector for normalization (see further). All also take part in the setting up and running of both off-line and on-line measurements.

3. Status

In the period June-November 2004 the different sections of the set-up have one by one been taken into operation. Since then the set-up has been further optimised and a significant gain in overall efficiency was realized: a factor of 10 to about 100 was gained during the last 3 years. The status in February 2005 and at present is illustrated in the table below. Most of these values (especially the trap efficiencies) were deduced from the tests with 30 keV stable ^{39}K and ^{133}Cs ion beams from the REXTRAP ion source. Efficiencies are given relative to the intensity of the beam that is obtained from REXTRAP (the transport efficiency between the ISOLDE separators and REXTRAP is about 85%, while the total efficiency of REXTRAP is typically about 40%).

Section	Ideal efficiency (%)	Efficiency 2005 (%)	Efficiency 2007 (%)
Transport through horizontal beam line	100	100	100
Pulsed drift tube (30 keV → ~100 eV)	50 – 100	10	50 – 100
Injection of beam into 9 T magnetic field	100	1 – 10	20
Trapping of ions in the cooler Penning trap	100	50	50
Transfer to decay Penning trap	100	70	70
Storage in decay ion trap	100	(100)	100
Fraction of ions from trap to spectrometer (solid angle, trapped after decay)	45	(45) [a)]	(45) [a)]
Fraction of the lowest charge state after β^+decay	10	(10) [b)]	(10) [b)]
Transmission through spectrometer	100	(100)	~ 100
MCP detection efficiency	60	52 [c)]	52 [c)]
Total efficiency (from REXTRAP to capture in the decay trap)	~ 1 – 2 %	~ 10^{-3} to 10^{-2} %	~ 0.1 – 0.2 %

Table 1. Efficiencies for the WITCH set-up in January 2005 and December 2007. Efficiencies that have not yet been determined directly are between brackets. Predicted values were then used.

a) This value is slightly depending on the recoil ion energy.

b) The recoil spectrum of the lowest charge state is used to extract the beta-neutrino correlation coefficient. For β^+decay this is the 1^+ charge state. The corresponding value for β^- decay (2^+ charge state) is about 80%.

c) This value has been determined by the LPC-Caen group [LIE05].

3.1 Accumulation and bunching in REXTRAP

The REXTRAP Penning trap is used to accumulate ions from a DC beam from ISOLDE or from the REXTRAP ion source for some time and then release these as a bunched beam towards the WITCH horizontal beam line. Presently the WITCH experiment runs at a repetition rate of 1Hz or slower, compared to the 49 Hz repetition rate of REXTRAP during REX-ISOLDE experiments. This means that the cooling period in REXTRAP (20 ms at 49 Hz) can be adapted (up to about 1 s) for the WITCH purpose. However, depending on the isotope of interest, this can demand stronger vacuum requirements in order to make a longer storage in REXTRAP efficient (e.g. because of charge exchange losses).
The WITCH team learned how to operate REXTRAP and run this device independently during WITCH testing and on-line beam times. Over the past three years a systematic study of the optimal operating conditions of REXTRAP for WITCH purposes was performed. An important result of this was the optimisation of the time structure of the bunch ejected from REXTRAP, such that this now fits completely into the WITCH pulsed drift tube (figure 3). This has improved the efficiency of the pulsed drift tube by about a factor 2.

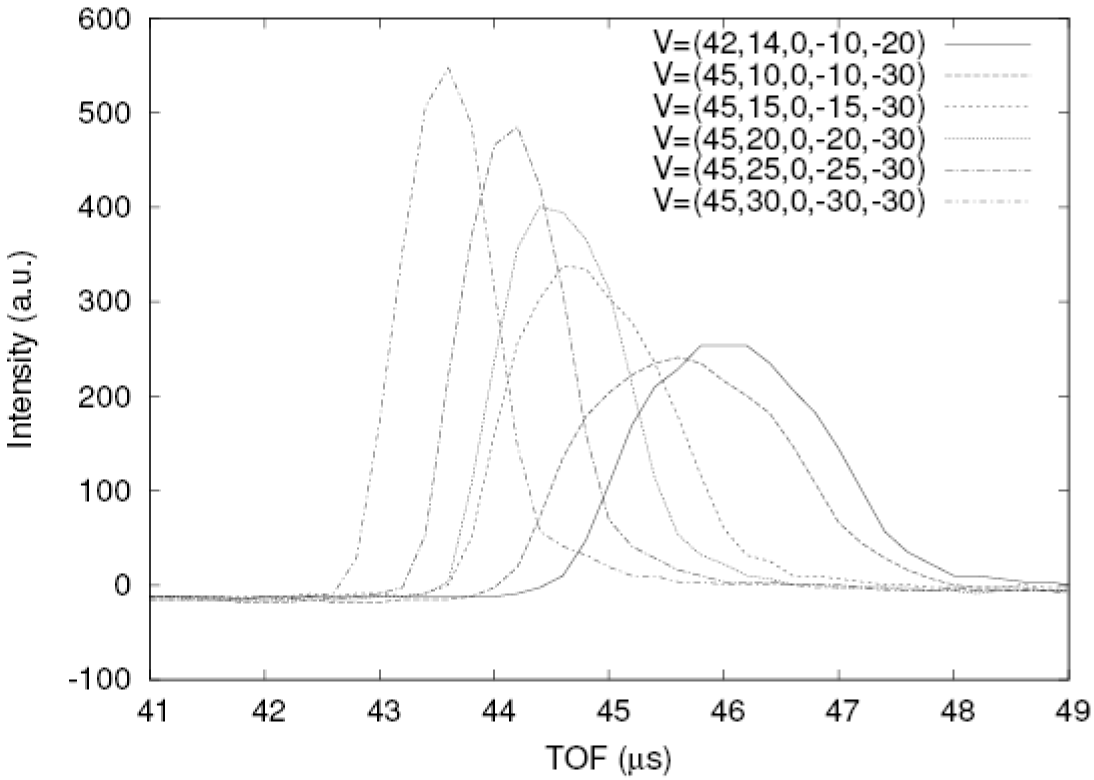

Figure 3: TOF structure of a bunch of 39K+ ions at the exit of REXTRAP for different ejection voltages. The voltages applied each time on the five central REXTRAP electrodes are indicated between brackets. The rightmost curve is the one that was in use in January 2005, the leftmost curve is the one in use now.

3.2 Micro channel plates for beam diagnostics

It was recognized in 2004 that the micro channel plate (MCP) detectors that were used for beam diagnostics could not cope with the high instantaneous beam intensity of the pulsed WITCH beams. Significant saturation effects (i.e. dead times) were observed rendering accurate efficiency determinations and good beam tuning very difficult. These effects were investigated in detail by comparing experimental results obtained with an off-line ion source with simulations. The saturation effects were studied as a function of beam intensity, MCP voltage and pulse time interval

[COE06]. To avoid these saturation effects semi-transparent grid foils were installed in front of all beam diagnostics MCP's. For readout the outputs of the MCP's are now connected to an oscilloscope via a 1 kΩ termination (instead of 50 Ω) and no amplifier is used, while a lower MCP operating voltage is used as well.
In addition, the MCP's have been modified so that a position sensitive signal is now obtained. Due to the very small space available a home-made segmented anode was developed for this purpose. This consists of two mutually perpendicular sets of 11 wires each, with a full-metal anode plate behind. This has helped a lot in improving beam tuning throughout the set-up.

3.3 Pulsed drift tube

The WITCH experiment uses a pulsed drift tube to change the beam energy from 30 keV to the few 100 eV needed for trapping in the cooler Penning trap. To find the optimal parameters for the use of this pulsed drift tube the behaviour of this device was investigated systematically in a series of dedicated measurements that used beams ranging from ^{20}Ne to ^{128}Xe and which were combined with simulations. A detailed report on this can be found in [COE07a].
In addition, a beam gate was installed in the horizontal beam line, in order to remove any remaining ions that still cannot be pulsed down fully. This avoids that high-energy (i.e. non-pulsed 30 keV) ions enter the vertical part of the WITCH system thereby possibly contaminating the recoil ion detector at the top.

3.4 Injection into 9T magnetic field

The above mentioned improvements, in combination with an improved version of the control system, which now allows for much faster beam tuning (i.e. factor of about 10) and much better control over correlations between different ion optical elements, have lead to an improvement of the efficiency for injection into the magnetic field of about a factor 2 to 20. There is still room here for a further improvement by a factor of about 5.

Concluding, the work performed on the shortening the REXTRAP pulse, the new diagnostic system and the better understanding of the response of the MCP's to pulsed beams, the optimisation of the pulsed drift tube, and a new and much improved version of the control system have resulted in an overall increase of the beam transport efficiency in the vertical beam line, including the injection of the beam into the magnetic field, of up to two orders of magnitude.

3.5 Penning traps

Figure 4 shows the WITCH double Penning trap structure. Both traps are of the cylindrical type and are positioned in a 9T magnetic field. The field homogeneity is specified to be about 10^{-6} in a sphere of 1 cm diameter, centred around each of the two trap centres.

a) cooler trap
The specific dimensions and voltages of the electrodes of the cooler trap allow creating a harmonic trap potential in the centre of the structure. The presence of He-buffer gas atoms inside the cooler trap volume combined with an RF quadrupole field at the pure cyclotron frequency ω_c allows to cool and center ions of one specific mass. The trap depth inside the cooler trap (between centre of the trap and end cap electrode) is 18.5V. To capture the incoming ion bunch from REXTRAP a large box-like potential with barriers of about 100V is applied.
So far about 50% of the incoming ions can be trapped in the box potential of the cooler trap. Fig. 5 shows that ions can be kept in the cooler trap for up to about 1 s without significant losses (without buffer gas). The transfer efficiency between the cooler and decay trap is of the order of 70%.

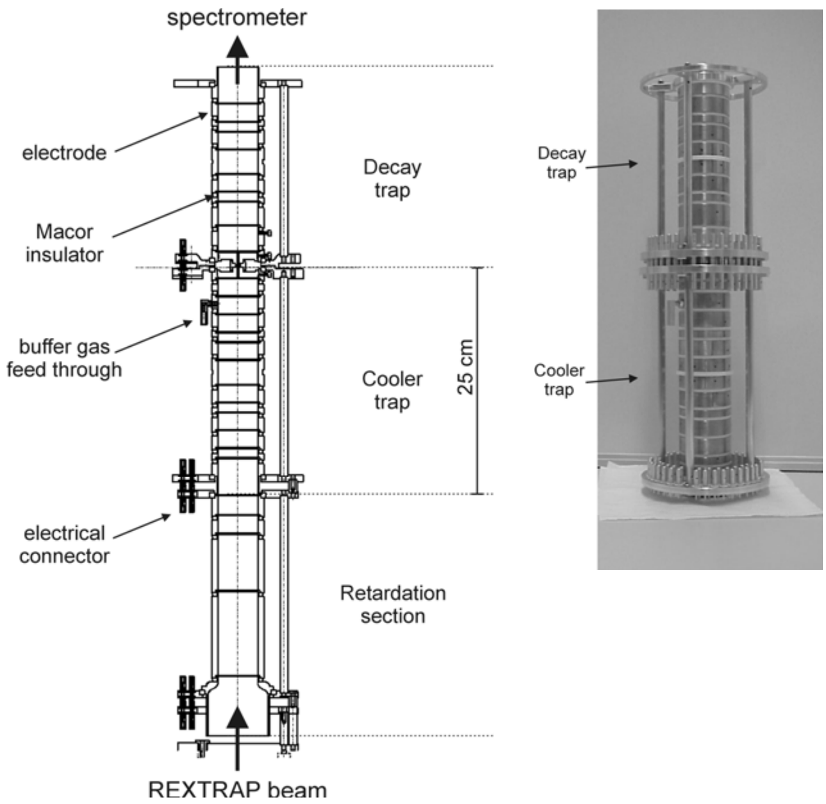

Figure 4. Double Penning trap structure of the WITCH-set-up

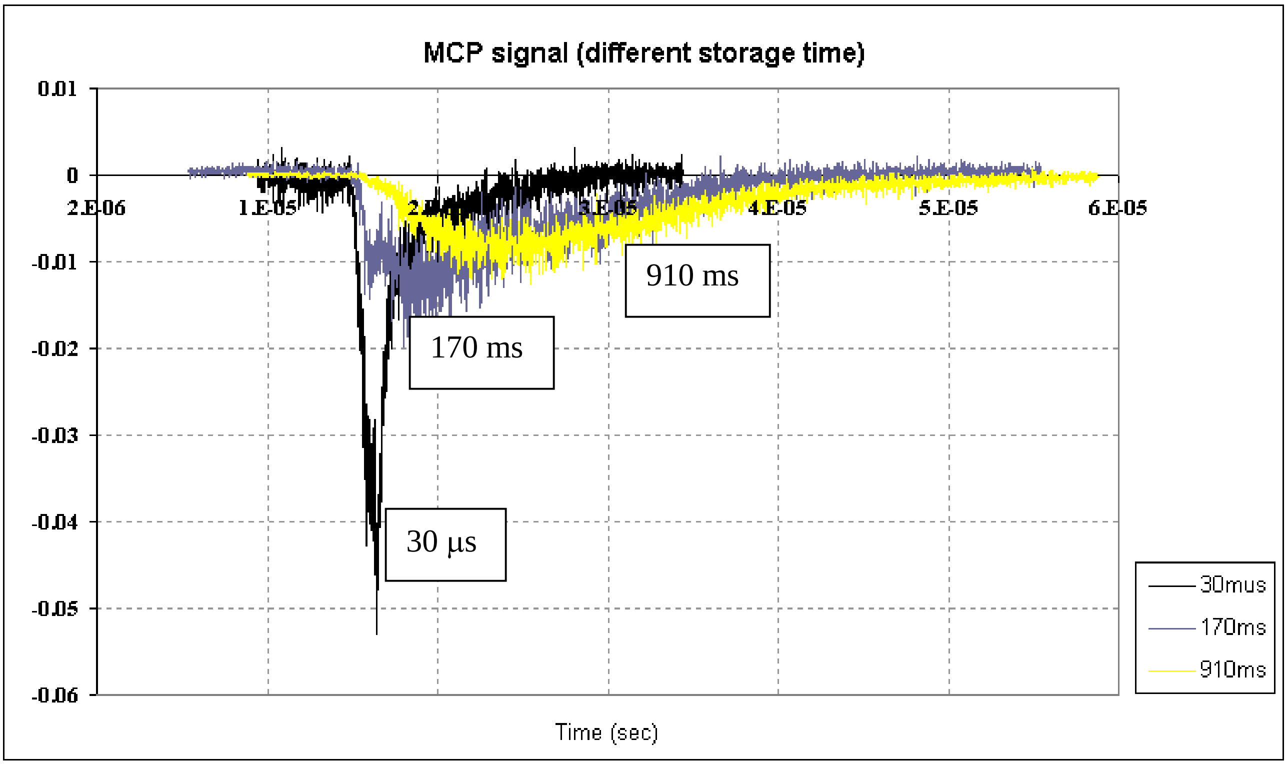

Figure 5: TOF signal on the MCP detector behind the Penning ion traps for different storage times of ^{39}K ions in the cooler trap (box trapping; no buffer gas; 6 T magnetic field). Note also the longer time-of-flight for the longer storage times, indicating the cooling of the ions.

b) decay trap

The decay trap differs from the cooler trap in its length and in the number of end cap electrodes. The core of both traps, consisting of a ring electrode and several correction electrodes, is identical. Also in this trap, storage times of the order of 1 s have been realized.

c. behaviour of ion cloud in a Penning trap

Extensive simulations have been performed to study the behaviour of small ion clouds (typically about 500 to 1000 ions) in a Penning trap [COE07b]. This is considered to be the first step towards understanding the behaviour of large ion clouds and as a starting point for a full Monte Carlo simulation based analysis of WITCH experimental data that is being prepared in Münster [FRI07]. Further, also the effect of having simultaneously two different ion species with nearly equal mass in a Penning trap was investigated using simulations [COE07b].

d) new ion trap system

After it was noticed that the electrical field inside the Penning traps was most probably not according to the specifications, two new but mechanically identical Penning traps were built in the first half of 2007. The original set was from the beginning meant only for the testing phase and was therefore also not properly coated. This time the traps were coated, first with silver and then with a layer of gold, at the GSI-Darmstadt. These new traps were installed in July 2007 and then extensively tested. They turned out to perform much better than the original ones. A mass resolution $M/\Delta M$ of about 2×10^5 was now readily obtained (see figure 6), whereas with the original set only about 2500 was reached.

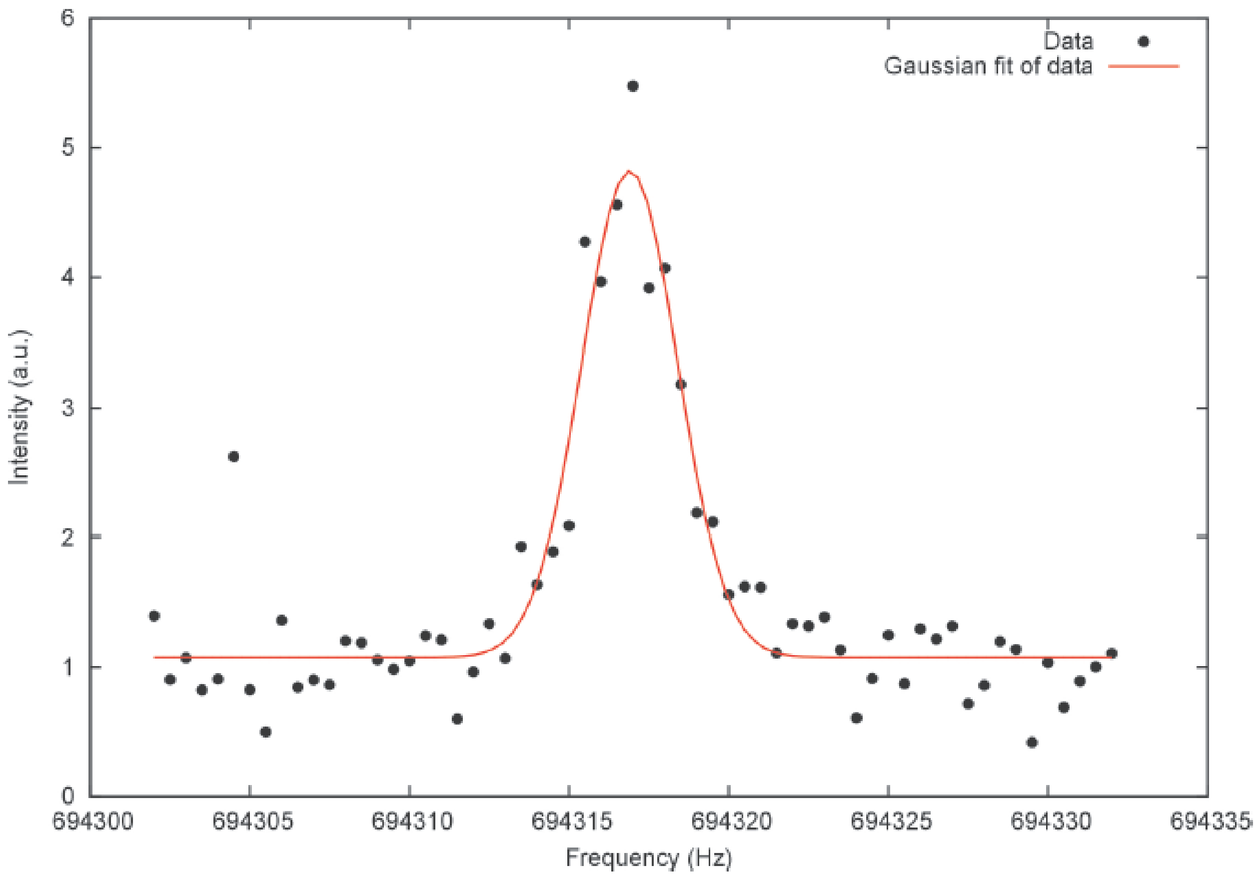

Figure 6: Amplitude versus quadrupole frequency (in Hz) during a quadrupolar excitation on ^{39}K in a 9 T magnetic field. A mass resolution of 2×10^5 was obtained.

4. Retardation spectrometer

After the radioactive nuclei have decayed in the decay trap, their recoil energy allows them to escape out of the trapping potential and enter the spectrometer where an electrostatic retardation barrier is applied by a series of 6 electrodes (Fig. 7). Almost 99% of the radial energy of the ions is converted into axial energy before they reach the retardation barrier. Those that make it over the barrier are then accelerated to 7 kV and focussed onto the MCP recoil ion detector. Ideally an acceleration voltage of 10 kV is aimed at, but a problem of discharges in this upper part of the spectrometer presently does not allow to go higher than 7 kV. It is thought that this is related to not sufficiently rounded edges on some of the electrodes. These parts will therefore be re-machined.

5. Recoil ion MCP detector

In the summer of 2006 the original 2 cm diameter MCP detector (similar to the beam diagnostic MCP's) that was initially installed, was replaced by a 4 cm diameter position sensitive MCP detector (with delay line anodes) that was borrowed from the LPC-Caen group. This detector was extensively tested and characterized by them already [LIE05].

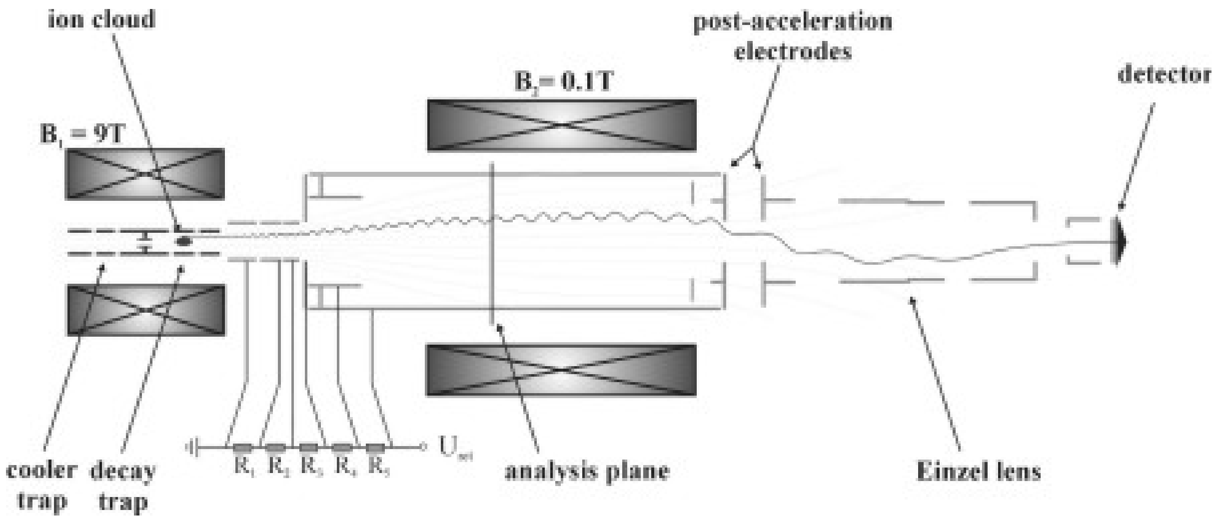

Figure 7: Lay-out and principle of the WITCH retardation spectrometer

6. First measurement of a recoil ion spectrum with WITCH

In November 2006 a first complete experiment was performed with WITCH, successfully demonstrating the proof-of-principle of the experiment.

In order to have a large count rate the β^- emitter ^{122g}In was chosen for this. A β^- emitter was chosen as after the β^- decay of a 1+ ion all the daughter ions are charged, while this is only about 10% for a β^+ decay. This isotope moreover has a decay scheme that is sufficiently simple that the data obtained can be analysed in terms of a possible tensor type contribution to the weak interaction. No ^{122g}In was observed, however, and detailed yield measurements showed that the yield for ^{122g}In and ^{122m}In listed in the ISOLDE yield database are in fact the yields for ^{122m1}In and ^{122m2}In (only one isomer was known when these yields were measured at the previous ISOLDE-3 facility). We finally decided to perform this first measurement with ^{124g}In. This beam turned out to be a mixed ^{124g}In (t1/2 = 3.1 s) and ^{124m}In (t1/2 = 3.7 s) beam.

Figure 8 shows the first data that were obtained. The length of the measurement cycle was 4.5 s. During the first 1.4 s ions are cooled and stored in the cooler Penning trap. The radioactive decay during this period is reflected by the decrease of the count rate. After 1.4 s the ions are transferred to the decay trap. The sudden spike indicates that some ions were not stopped in the decay trap but were shot through. This caused a temporary saturation of the MCP detector. After 2.4 s, when the detector had fully recovered, the spectrometer was either switched 'on', thereby stopping all ^{124}In

recoil ions, or off (i.e. letting all recoil ions pass). A clear difference in count rate was observed for these two conditions, proving the correct operation of the spectrometer. The background count rate that is left when all recoil ions are retarded is due to β particles that fly through the spectrometer and reach the MCP detector as well as from the ions that were implanted during the 'spike' at 1.4 s.
The pulse-hight distribution for the conditions with retardation voltage 'on' and 'off', as well as the difference is plotted in figure 9. A clear difference in pulse-hight distribution for the recoil ions (Gaussian shape) and β particles (exponential shape) can be seen.

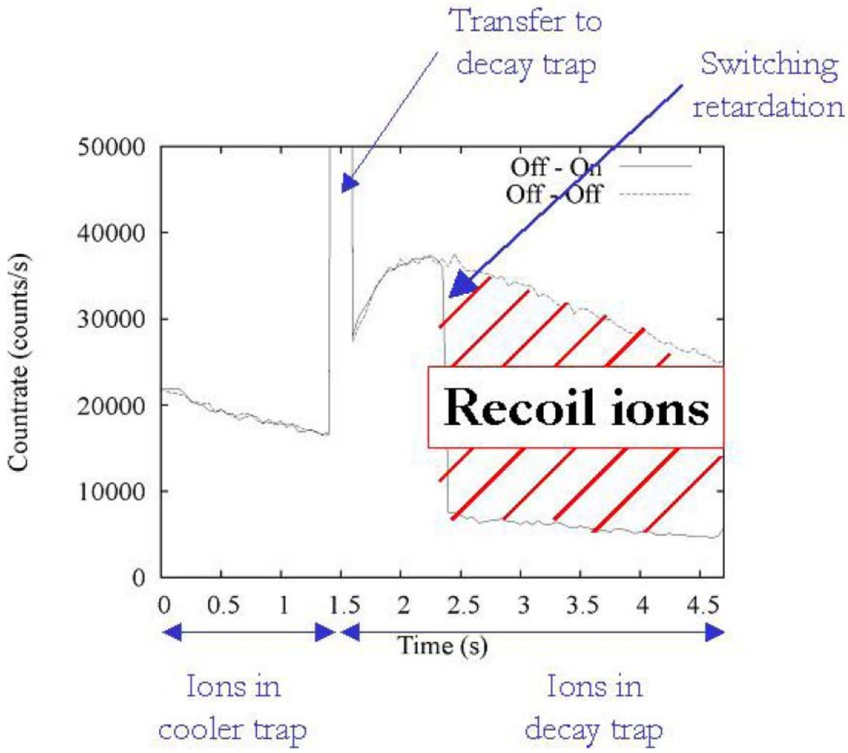

Figure 8. Count rate on the recoil ion MCP detector during a so-called on-off measurement with ^{124}In. Details are given in the text.

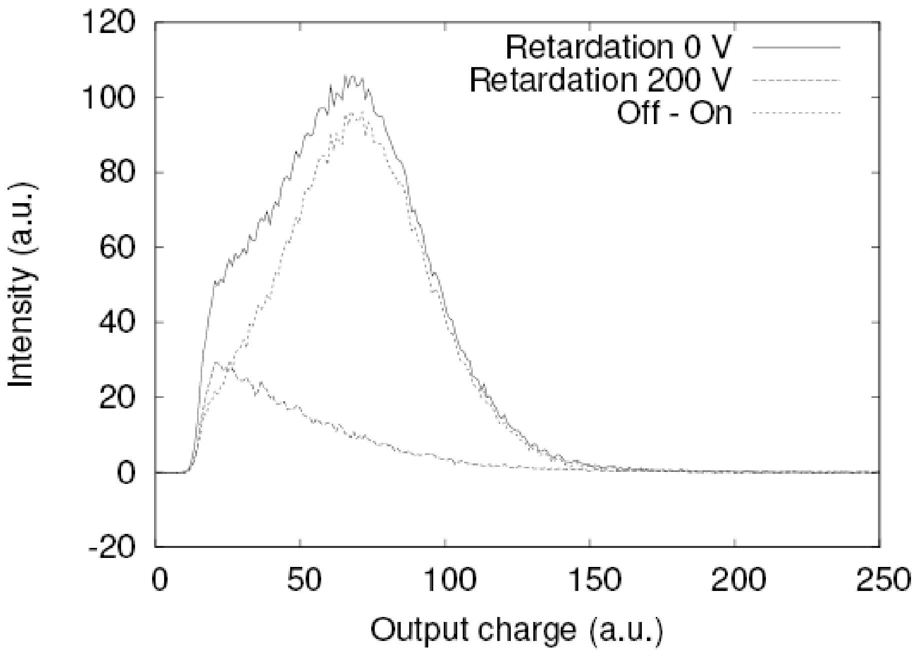

Figure 9. Normalized pulse-hight distributions for retardation 'on' and 'off' as well as the difference plot, showing the different pulse-hight distributions for the recoil ions (Gaussian) and β particles (exponential).

Thereafter, the energy spectrum was measured. For this the retardation voltage was increased in steps of 10 V from 0 V up to 220 V. The resulting integral spectrum is shown in figure 10. These measurements were performed with several 10^5 ions per trap load in the decay trap.

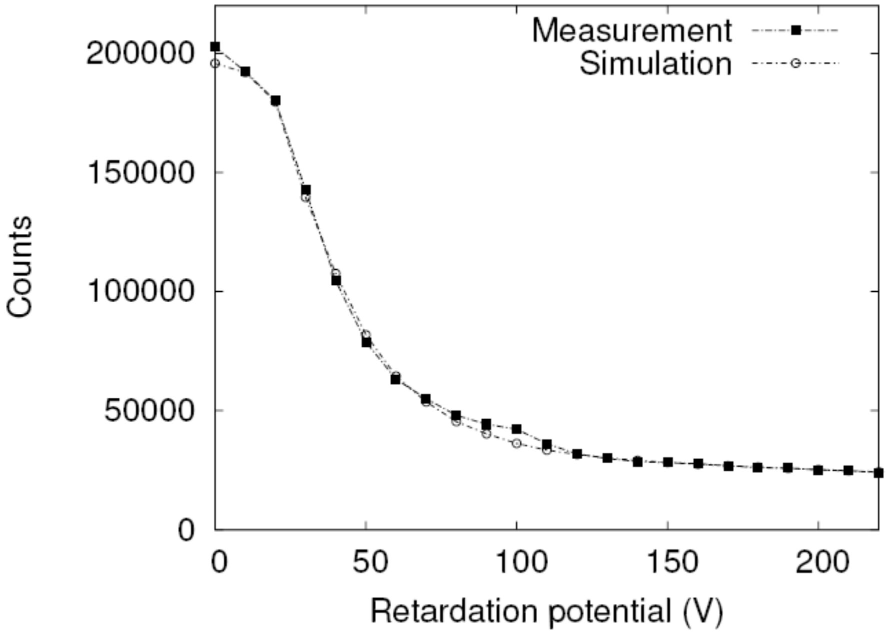

Figure 10. Measured recoil ion energy spectrum for ^{124}In. Error bars are smaller than the size of the data points. For details see text.

As the charge state distribution after β^- decay of ^{124}In was not known yet this was extracted from the analysis of the experimental data. The point at 0 V and the three points around 100 V retardation potential, which were later shown to be experimental artefacts, were omitted. Assuming an exponentially shaped charge state distribution for pure β^- recoils and a Gaussian charge state distribution for decay branches undergoing internal conversion, as was previously observed in other experiments, the charge state distribution shown in figure 11 was obtained.

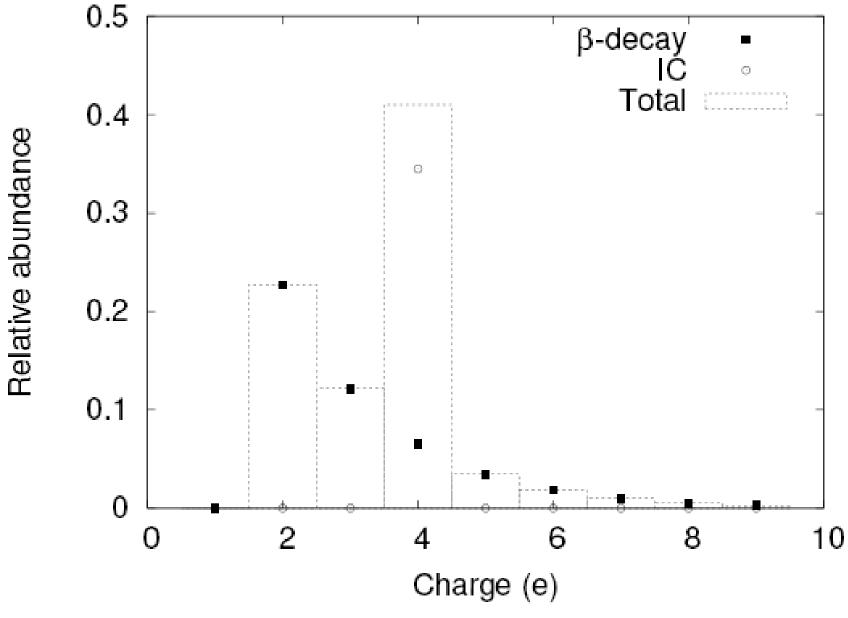

Figure 11. Charge state distribution of the recoil ions from the β^- decay of ^{124}In as obtained from fitting the experimental recoil ion energy spectrum of figure 10.

The fit results were shown to be very stable against variations of the different input data and were interpreted in view of the electronic structure of the Sn daughter ion [COE08]. This is the first time a charge state distribution for beta decay of an ion has been measured.

7. First measurement with ^{35}Ar.

A first measurement with ^{35}Ar (our physics candidate for a measurement testing scalar currents) was tried at the end of the ISOLDE running period in October 2007. Unfortunately this run failed, even though many things were tried to overcome the technical problems we were facing. Two major problems were encountered. The mass 35 beam turned out to contain about 400 times more stable ^{35}Cl (later identified as coming from the ion source and brought in there as part of a polishing agent). This could be reduced to a factor 20 by tuning the ion source. Trying to further clean the beam by applying isobar separation with REXTRAP (the mass difference was about 6000 while a mass resolution of 40000 was shown before for REXTRAP) failed, probably because of the large intensity difference between the two isotopes. To overcome this problem, the ISOLDE target group has in the mean time already taken action towards the production of a chlorine-free ion source for future measurements with ^{35}Ar.
In addition, much of the ^{35}Ar ions were lost both in REXTRAP and in WITCH due to charge exchange. This was even worsened in WITCH by the not ideal vacuum conditions (about 5 x 10^{-8} mbar, about a factor 5 worse than usual) due to an accidental venting caused by a power failure one week before the beam time.
As a result the amount of ^{35}Ar in the WITCH Penning traps was rather weak and more than 95% of the ions in the traps were stable ^{35}Cl ions, rendering a recoil spectrum measurement impossible.
During this run with ^{35}Ar we also observed an as yet unexplained production of secondary ions in the spectrometer, which was clearly related to the presence of radioactivity in the system. This will be further investigated with radioactive sources in off-line conditions.

8. Further improvements of ion beam and WITCH towards a recoil ion spectrum for ^{35}Ar.

With respect to the ^{35}Cl contamination in the beam the target group found out that it is in limited quantity present in the CaO target material but also in the materials that are used for the target unit cleaning. Measurements will be performed with the off-line separator to study Cl suppression for Ar ionisation with the MK7 ion source. If needed action will be taken to find different suitable target materials and cleaning procedures.

From the side of REXTRAP action will also be taken to use the selective mass cooling principle inside the REXTRAP, such that a remaining ^{35}Cl contamination can be removed by selective mass cooling inside the REXTRAP.

Further, actions are being taken to increase the Ar lifetime in REXTRAP, which is presently ~60 ms and limited by charge exchange inside the trap: exchange the teflon gas tube inside the trap, try to operate with He as buffer gas, try to operate with a lower buffer gas pressure, increase the pumping speed to remove outgassing contaminations.

The following actions are being taken/planned to improve the WITCH system:

1. before proceeding to a new measurement with ^{35}Ar the vacuum system will be improved to guarantee a vacuum of 1 x 10^{-9} mbar in the Penning trap regions and in the spectrometer (now about 1 x 10^{-8} mbar). To this end so-called NEG getter strip pumps will be added into the system and all teflon components will be removed;

2. the buffer gas system will be improved so as to have less contaminant atoms in the Penning traps;

3. several spectrometer electrodes which cause a charging/discharging effect limiting the recoil ion post-acceleration voltage to 7 kV will be re-machined, to obtain better rounded edges, and electro-polished;

4. to study the as yet unexplained creation of secondary ions that was observed during the run with ^{35}Ar, measurements with radioactive β^+, β^- and γ-sources will be performed and the possible existence/effect of a Penning trap for electrons in the retardation spectrometer will be investigated in collaboration with F. Glück (FA Karlsruhe).

5. the use of the 9 T magnetic field is still rather restricted in time as it creates an about 5 to 10 Gauss stray field at the neighbouring REX-ISOLDE beam line that is heavily used. The effect of this stray field on other beam lines in the ISOLDE hall and specifically for the tuning of REX-ISOLDE beams has been investigated in detail [COE04, VOU07]. Simulations [TAN07] have shown that a magnetic shield around the WITCH set-up would be very heavy and much less effective than installing a magnetic shield around the part of the REX-ISOLDE beam line just behind the EBIS (including the separator) and around the vertical section of the beam line below the separator. This is being prepared now.

6. a new support structure for the Penning traps will be constructed allowing to install a NEG pump close to the traps and to include a normalization detector inside the pumping diaphragm;

7. in February 2006 a 60 kV ion source was installed in the horizontal beam line so as to be independent of the REXTRAP ion source for off-line testing. The yield of this source when used in pulsed mode turns out to be rather low, however. To overcome this, the focusing electrode will be replaced by a RFQ-buncher which should, in addition, improve the beam emittance;

8. the WITCH collaboration is very interested to test (off-line) the possibility to use ISOLDE beams via the new ISCOOL buncher instead of via REXTRAP. The much better beam emittance of ISCOOL could be of significant importance to further improve the beam injection efficiency into the 9 T magnetic field.

9. a new and better alignment of the entire WITCH set-up (beam lines, trap structure, magnet system) is planned, which could improve the overall efficiency of the system;

10. a dedicated set-up to directly measure the charge state distribution after beta decay will be developed. This charge state distribution will then be used as input for fitting the recoil-ion energy spectrum. Simulations have already shown that a TOF method does not allow to fully separate the difference charge states. Alternatives that will still be investigated are i) the possible use of a energy sensitive detector with a very thin (< 25 nm) dead layer and ii) of a magnetic bender in combination with a MCP detector. All methods always involve post-acceleration of the recoil ions to 10 - 30 keV.

9. Extending the measurement possibilities of WITCH

Several actions to extend the measuring possibilities of the WITCH set-up are ongoing. These will make use of the fact that an intense (up to at least 10^6 ions in the Penning traps, per trap load) and clean radioactive source free of scattering effects, can be prepared with WITCH. They include:

- the installation of a tape station on top of the WITCH set-up for trap-assisted spectroscopy;

- inserting a scintillation detector for normalization of the recoil ions energy spectrum in the pumping diaphragm between the two Penning traps;

- installation of a Si detector behind the Penning traps for in-trap spectroscopy; tests with a pin-diode Si detector have shown that these detectors function well in magnetic fields up to at least 12 T, with a limited loss of energy resolution (almost factor 2);

- the construction of a compact beta-spectrometer that can operate in vacuum and will consist of the combination of a multi-wire drift chamber and an energy-sensitive Si detector, for precision beta particle spectroscopy. The drift chamber will allow to recognize backscattered events on the Si detector. In combination with a scattering-free source in the Penning trap this system, when installed inside WITCH, will permit to construct beta-spectra free of scattered events.

10. Request for beam time

With 5 x 10^6 ^{35}Ar ions per bunch from REXTRAP, assuming an about 2 times larger efficiency than at present, and with a measurement cycle of 1 s (i.e. slowing down, trapping, cooling, transfer, decay, and energy measurement) about 5 days of measurement time are required to reach a 0.5% precision on the beta-neutrino correlation coefficient.

In order to measure the recoil ions energy spectrum for ^{35}Ar, we ask for 27 shifts with ^{35}Ar, spread over three runs. First beam will be asked only after the problem of the beam contamination will be solved and the vacuum upgrade will have been realized. We plan to realize the first eight WITCH-upgrade items (par. 8) by the summer. A first run could then hopefully take place in autumn.
The first run will be to verify whether the entire ISOLDE & WITCH system is operating in conditions favourable to measuring a recoil ion energy spectrum with ^{35}Ar, to be followed by first data taking. The second run will be the main data-taking run. The third run will be used to characterize systematic effects related to the operation of the spectrometer that can only be addressed with a radioactive beam.

Table 2. Beam time request.

Run	Beam	Min. intensity	Target material	Ion source	Shifts
1	^{35}Ar	1 x 10^7/s	CaO	plasma cooled transfer line	6
2	^{35}Ar	1 x 10^7/s	CaO	plasma cooled transfer line	15
3	^{35}Ar	1 x 10^7/s	CaO	plasma cooled transfer line	6 Total = 27

Experimental apparatus to be used : WITCH

Data handling requirements : We ask to use the ISOLDE DAQ for our on-line runs.

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